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SMALL SEED TRAPS PERFORM WELL IN THE DOUGLAS-FIR TYPE OF CALIFORNIA

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Seed production and dispersal are among the most important silvical characteristics considered by foresters who manage forest land. Expected seedfall patterns provide guides for cutting and regeneration practices. Accurate measurements of the amount and distribution of seeds are necessary, therefore, to compile data for estimating future delivery of sound seed to the ground.

The standard seedfall sampling device used in California for several years is a seed trap having an effective area of 8.2 square feet. The frames of these traps, including a stiffener through the center, are constructed of 1- by 4-inch redwood lumber. The tops (1/2-inch hardware cloth) and bottoms (fly screen) are held in place by redwood molding (Fowells et al., 1956).

These large wooden seed traps have several disadvantages. One detriment is the expensive construction. Another is the difficulty of handling. The traps can't be carried conveniently, particularly on steep ground covered with slash or brush, because the outside dimensions (approximately 3 feet) are too large. The fixed top, which cannot be removed to clean the trap, is a third disadvantage.

The Pacific Southwest Forest and Range Experiment Station was formerly known as the California Forest and Range Experiment Station.

A different kind of seed trap constructed entirely of hardware cloth and window screen has been described (Boe, 1955) (Fig. 1). This trap is only 1 foot square. It can be fabricated at reasonable cost 1/ and its small size and light weight permit easy handling in the field. As many as 20 of these traps can be carried comfortably at one time.

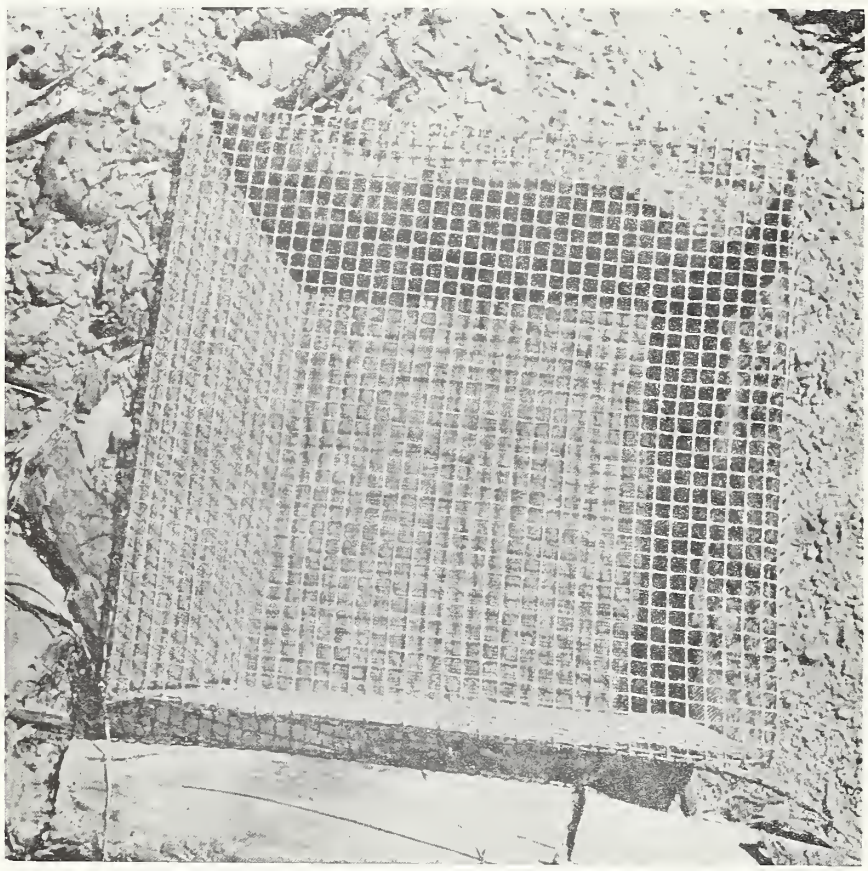

Figure 1. --A 1-foot-square wire seed trap in place. The basket is formed from 18 x 14 mesh galvanized wire screen cloth, and the top from 3 mesh galvanized hardware cloth.

1/ Costs for fabricating 1-foot-square wire seed traps:

	1955	1956
Labor at $1.80 per hour	$0.54	$0.43
Window screen (20 x 20 inches)	.36	.36
Hardware cloth (15 x 15 inches)	.16	.16
Fine wire, staples	.01	.01
Total cost per trap	$1.07	$0.96
Basis: number of traps	100	300

Although several advantages favoring the small traps were apparent, their performance in catching Douglas-fir seed was unknown. One small study in the Pacific Northwest showed that 1-square-foot, all-screen traps caught slightly more seed per square foot than 6-square-foot wood and screen traps (Anon., 1950; Anon., 1951). The 1-square-foot model used in the present study furnished an estimate of the amount of seed produced by a bumper cone crop of western larch. The mean number of seeds caught per trap was almost identical to the number of seeds per square foot caught by one-quarter milacre traps, but the variation was somewhat greater (Boe, 1955). Would the 1-square-foot seed traps function as well as the "standard" 8.2-square-foot traps in the Douglas-fir type of California?

A trial designed to compare the efficiency of the two traps began on the Brush Mountain Unit, Six Rivers National Forest, in 1955. Small traps were paired with 100 large traps placed throughout a clear-cut block and under the surrounding edge of Douglas-fir timber (Figs. 2 and 3). The ground sloped toward the east at an average rate of 34 percent.

Seedfall in 1955 was too scanty to analyze seed trap efficiencies. In 1956, however, Douglas-fir produced a bumper seed crop and the numbers of seed caught by 90 pairs of traps were recorded. Data for the remaining ten pairs were lost because traps were disturbed by falling branches, deer, or bears.

Data were stratified by 1-chain increments beginning 2 chains within the timber border and extending 5 chains into the cutover. The mean number of sound seed per square foot, variance, fiducial limits. and coefficient of variation were calculated for each trap size in each stratum (Table 1). Variances obviously were heterogeneous.

Variance in the seed catch of traps on clear-cut blocks can be attributed to two components. The first component is generated by the relationship of two factors--the amount of seed falling and the trap size. Variance decreases as seedfall increases from light to heavy, and as trap size increases. When seedfall is light we expect less variation in the seed catch of large traps than of small traps; and for traps of a given size we would expect more variation in the catch during light seed years than in heavy. Since the number of seeds falling to the ground is intimately associated with distance from the timber, we would expect variance ascribed to the first component to be less for traps placed under or near the timber than for those in the cutover.

The second component of variance originates from seedfall "shadow" cast by tree boles, crowns of trees with little or no seeds, or understory brush. Variance from this source is greater under or near the timbered border than toward the inner parts of a cutover area. It is not a function of trap size within the limits of practical dimensions. Inspection of the data for the different strata of distances from the timbered edge shows that seedfall shadows are by far the most important factor in the genesis of variance in seed trap catches (Table 1).

Table 1.--Sound Douglas-fir seed from the 1956 seedfall caught in paired 1-square-foot and 8.2-square-foot seed traps, Cutting Block A, Brush Mountain Unit, Six Rivers National Forest

Distance from timber edge	Observations	Sound seed in 1-square-foot seed traps					Sound seed per square foot in 8.2-square-foot seed traps				
		Mean	Variance	Fiducial limits (95%)		Coefficient of variation	Mean	Variance	Fiducial limits (95%)		Coefficient of variation
				Lower	Upper				Lower	Upper	
Chains	Number	----- Number of seed -----					----- Number of seed -----				
Timber											
2-1	12	12.17	36.70	8.32	16.02	0.498	8.97	38.33	5.03	12.91	0.690
1-0	11	6.91	45.49	2.39	11.43	.975	6.42	30.50	2.72	10.12	.860
Cutover											
0-1	24	4.67	14.58	3.06	6.28	.818	3.62	17.97	1.82	5.42	1.171
1-2	12	2.17	4.70	.78	3.56	1.000	1.53	2.07	.61	2.45	.941
2-3	18	.78	1.01	.27	1.29	1.282	1.22	1.01	.71	1.73	.820
3-4	10	.50	.94	.00	1.20	1.940	1.14	3.04	.00	2.38	1.403
4-5	3	1.00	.00	1.00	1.00	.000	.27	.14	.00	.94	1.370

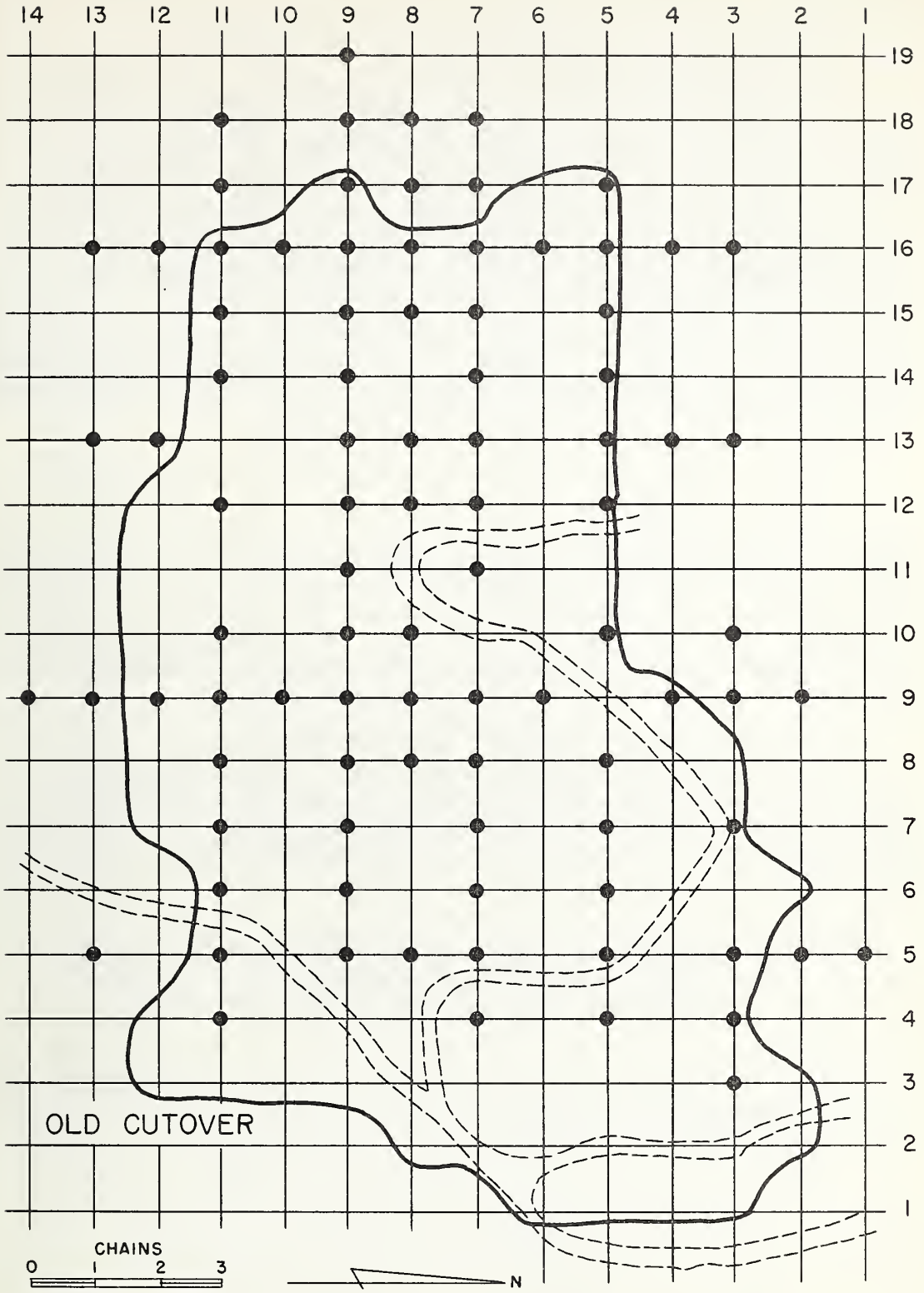

Figure 2. --Distribution of 90 pairs of large and small seed traps on Cutting Block A, Brush Mountain Unit, Six Rivers National Forest.

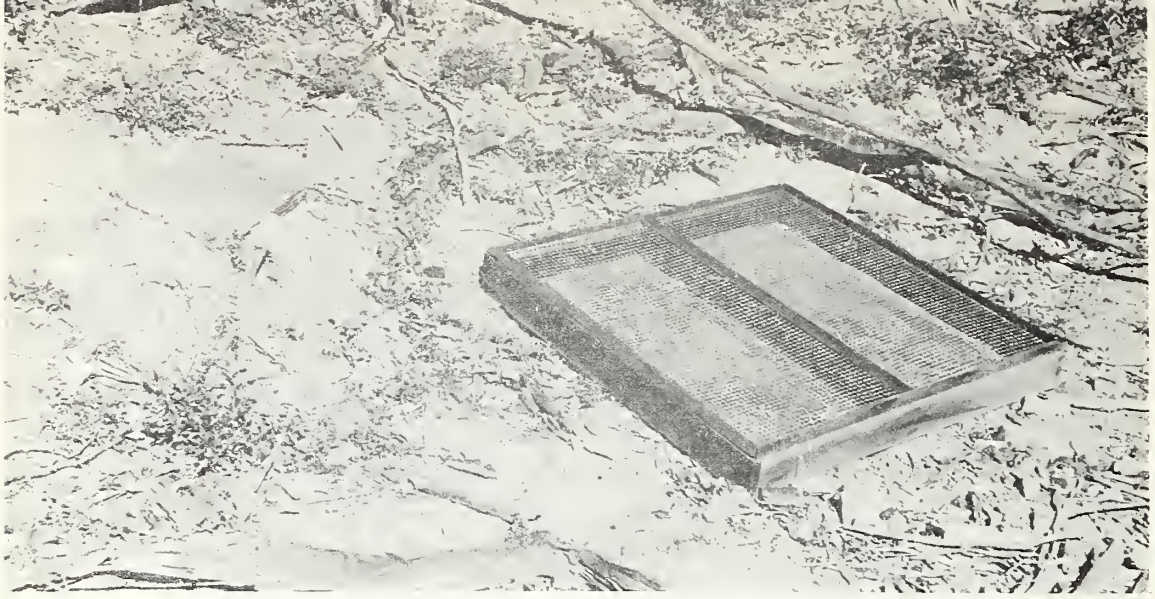

Figure 3. --A pair of seed traps in place. The effective areas are 1 square foot for the small trap and 8.2 square feet for the large trap.

The count data and heterogeneous variances dictated that "number of sound seeds per square foot" be modified by the $\sqrt{x+1}$ transformation. The statistic analyzed was the transformed "number of sound seeds in the 1-square-foot trap" minus the transformed "number of sound seeds per square foot in the paired 8.2-square-foot trap."

An analysis of variance (Table 2) showed:

1. The mean was not significantly different from zero.
2. The relationship between the numbers of sound seed caught by 1-square-foot traps and by the 8.2-square-foot traps was not dependent upon the distance from the timbered edge of the cutover block.

Table 2. --Analysis of variance for transformed seed trap data, 1956 seed fall, Cutting Block A, Brush Mountain Unit, Six Rivers National Forest

Factor	Degrees of freedom	Sums of squares	Mean square	F.	signifi-cance
Mean	1	0.9425	0.9425	1.7653	N.S.
Distance	6	5.3888	.8981	1.6822	N.S.
Error	82	43.7787	.5339		
Total	89	50.1100			

Hence, during a year of heavy seedfall the 1-square foot seed traps performed as well as 8.2-square-foot traps, and this performance was not affected by the distance from the seed source. Consequently, we can rely on small traps to sample seedfall accurately.

When seedfall is light, small traps will not sample seedfall, trap for trap, as accurately as large traps. But eight 1-square-foot traps dispersed through an area could be expected to sample seedfall more accurately than a single 8.2-square-foot trap.

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THE AUTHOR has studied forest management problems--in silviculture, mensuration, and regeneration--in California since 1946, when he joined the Station staff after graduation from the University of California. He is now in charge of the forest management research program in the North Coast Range and is concentrating his own work on regeneration of Douglas-fir.

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